# Attachment G - Impact of Hydraulic Dredging on Contaminant Fluxes

All of the remedial alternatives simulated as part of the lower 8.3 miles of the Lower Passaic River (LPR) ROD and RS assumed that mechanical dredging would be used. With that assumption, dredging releases were simulated as being split equally between the bottom layer of the model water column where the bucket cuts into the sediment and closes and the surface layer where the bucket breaks the surface of the water. The total rate of release was set at 3 percent of the mass dredged as a conservative estimate of the mass lost based on the environmental dredging pilot study and after consultation among the project team. As a result, 1.5 percent of the total mass dredged was released to the surface layer and 1.5 percent was released to the bottom layer of the model water column. If an alternative approach such as hydraulic dredging was chosen, the release of contaminant would all be at the bottom of the water column near the cutter head. A sensitivity run was done to assess the effect of using this alternative approach for the selected remedy. Simulations were conducted for the hydrodynamic, sediment transport, carbon and contaminant models where the release was entirely in the bottom layer. Although hydraulic dredging may reduce the overall rate of release, the 3 percent rate of release was kept constant for comparison purposes. Results of the comparison between the two simulations (releases in the bottom layer only, and releases in the surface and bottom layers) for water years 2020 and 2021 are summarized in this document.

Figures 1, 2 and 3 present the flux results for six locations along the LPR (RM 8.3, RM 6.6, RM 4.0, RM 2.1, RM 1 and RM 0). The top panel on each figure presents the hydrograph, and the second and third panels present the fluxes through two of the cross sections along the river. The flux panels show cumulative gross upstream flux (red lines), cumulative gross downstream flux (blue lines), and cumulative net downstream flux (green lines) of 2,3,7,8-TCDD. Note that range of the Y scale on the flux plots are not the same for all transects. The darker colored lines are the results from the run with the release in the bottom layer while the lighter colored lines are the results from the run with both surface and bottom layer releases.

The magnitude of the gross upstream and downstream fluxes in both runs increase moving downstream from RM 8.3 to the mouth of the Passaic River at Newark Bay (RM 0) as the cross section of the river increases. In both simulations some fraction of the mass released in the bottom layer settles back to the bed before it can be transported. This results in reduced fluxes away from the point of release, and reduced fluxes of the released contaminants out of the boundaries for the sensitivity with the full release in the bottom layer when compared to the simulation with releases in the surface and bottom layers. In addition, the releases to the bottom layer are more prone to landward transport due to estuarine circulation, particularly as one moves further downstream. The combination of these factors results in an overall reduction in transport that generally increases moving from RM 8.3 to RM 0. As a comparison of the two simulations, percent differences in the gross upstream, gross downstream, and net downstream fluxes are summarized in Table 1 for each of the locations considered.

Table 2 summarizes the net fluxes in the context of the dredging release between the locations during the two year simulation. Looking at the columns on the right of the table for the run with the releases in the bottom layer only, the net downstream flux at RM 8.3 is 2.1 grams over the course of the two years. Moving to RM 6.6 that increases to 22.4 grams (approximately equal to the dredging release of 22.6 grams between RM 6.6 and 8.3 during those two years), suggesting about 2.2 grams of net deposition over that reach. At RM 4.0 the flux increases slightly. With no dredging releases in this reach during this time period this suggests net deposition of about 0.8 grams. Between RM 4.0 and RM 2.1 there is another slight increase to 24 grams with 1.3 grams of dredging releases and 0.5 grams of net deposition between the two locations. Between RM 2.1 and RM 1.0 the flux increases by 2.6 grams with about 5.1 grams of dredging releases and 2.5 grams of net deposition. Finally, between RM 1and RM 0 the flux decreases slightly with 0.3 grams of net deposition and no dredging releases in the two year simulation period.

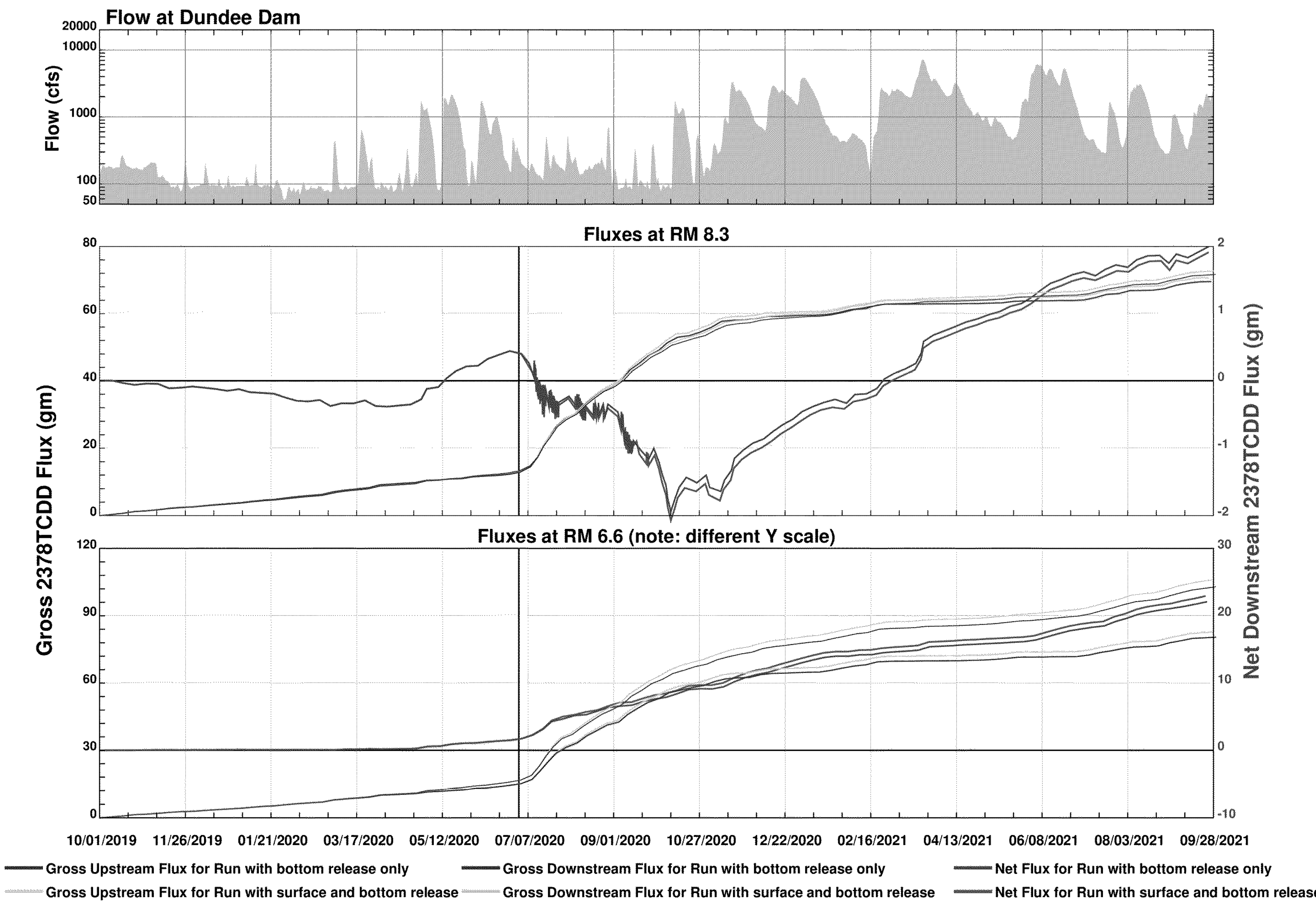
In general, the difference between the two simulations is small (around 5 percent), but the use of hydraulic dredging resulting in releases near the bottom and not near the surface of the water column may help reduce the net transport of contaminant resulting from dredging releases and flux of contaminants leaving the operable unit.

Table 1 Percent change in fluxes between runs

| Flux (gm) | RM 0 | RM 1 | RM 2.1 | RM 4 | RM 6.6 | RM 8.3 |
|---|---|---|---|---|---|---|
| Upstream | -4.9% | -5.2% | -4.2% | -3.7% | -2.8% | -1.6% |
| Downstream | -5.1% | -5.9% | -4.1% | -3.7% | -3.1% | -1.5% |
| Net Downstream | -6.5% | -6.8% | -3.8% | -3.6% | -3.9% | 4.4% |

Table 2 Fluxes, Releases, and Deposition

| | Surface and Bottom Release | | | Bottom Only Release | | | |
|---|---|---|---|---|---|---|---|
| Flux at RM | Net Downstream Flux | Dredge Release | Approximate Net Deposition | Net Downstream Flux | Dredge Release | Approximate Net Deposition | Release or Deposition in Reach |
| 8.3 | 2.0 | | | 2.1 | | | |
| | | 22.6 | 1.3 | | 22.6 | 2.2 | 8.3 to 6.6 |
| 6.6 | 23.3 | | | 22.4 | | | |
| | | 0.0 | -0.8 | | 0.0 | -0.8 | 6.6 to 4 |
| 4 | 24.1 | | | 23.3 | | | |
| | | 1.3 | 0.4 | | 1.3 | 0.5 | 4 to 2.1 |
| 2.1 | 25.0 | | | 24.0 | | | |
| | | 5.1 | 1.5 | | 5.1 | 2.5 | 2.1 to 1 |
| 1 | 28.5 | | | 26.6 | | | |
| | | 0.0 | 0.4 | | 0.0 | 0.3 | 1 to 0 |
| 0 | 28.1 | | | 26.3 | | | |



Flow at Dundee Dam
Flow (cfs)
20000
10000
1000
100
50
Fluxes at RM 8.3
Fluxes at RM 6.6 (note: different Y scale)
Gross 2378TCDD Flux (gm)
Net Downstream 2378TCDD Flux (gm)
80
60
40
20
0
2
1
0
-1
-2
120
90
60
30
0
30
20
10
0
-10
10/01/2019
11/26/2019
01/21/2020
03/17/2020
05/12/2020
07/07/2020
09/01/2020
10/27/2020
12/22/2020
02/16/2021
04/13/2021
06/08/2021
08/03/2021
09/28/2021
Gross Upstream Flux for Run with bottom release only
Gross Downstream Flux for Run with bottom release only
Net Flux for Run with bottom release only
Gross Upstream Flux for Run with surface and bottom release
Gross Downstream Flux for Run with surface and bottom release
Net Flux for Run with surface and bottom release

Figure 1 Flux comparisons at RM 8.3 and RM 6.6

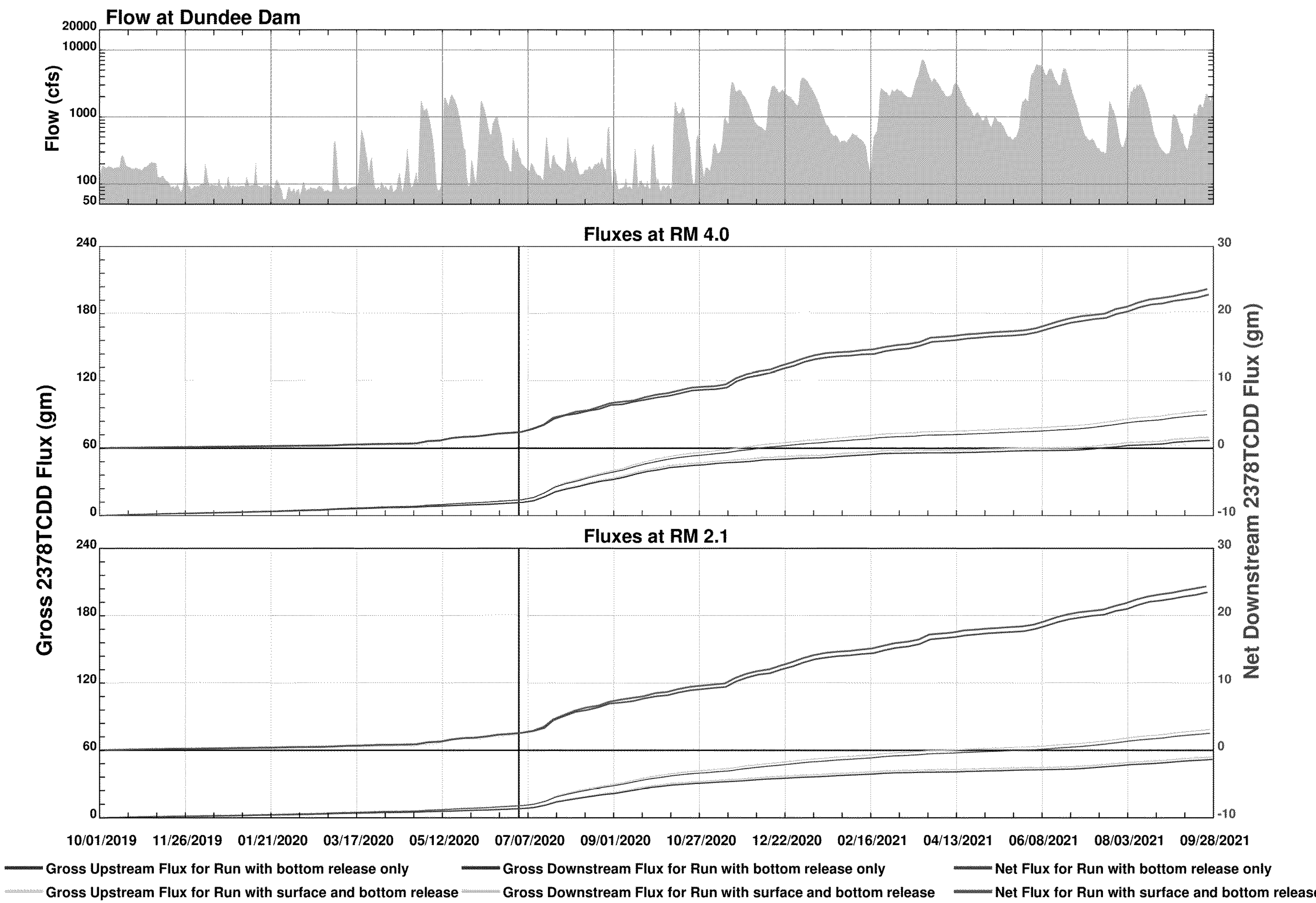
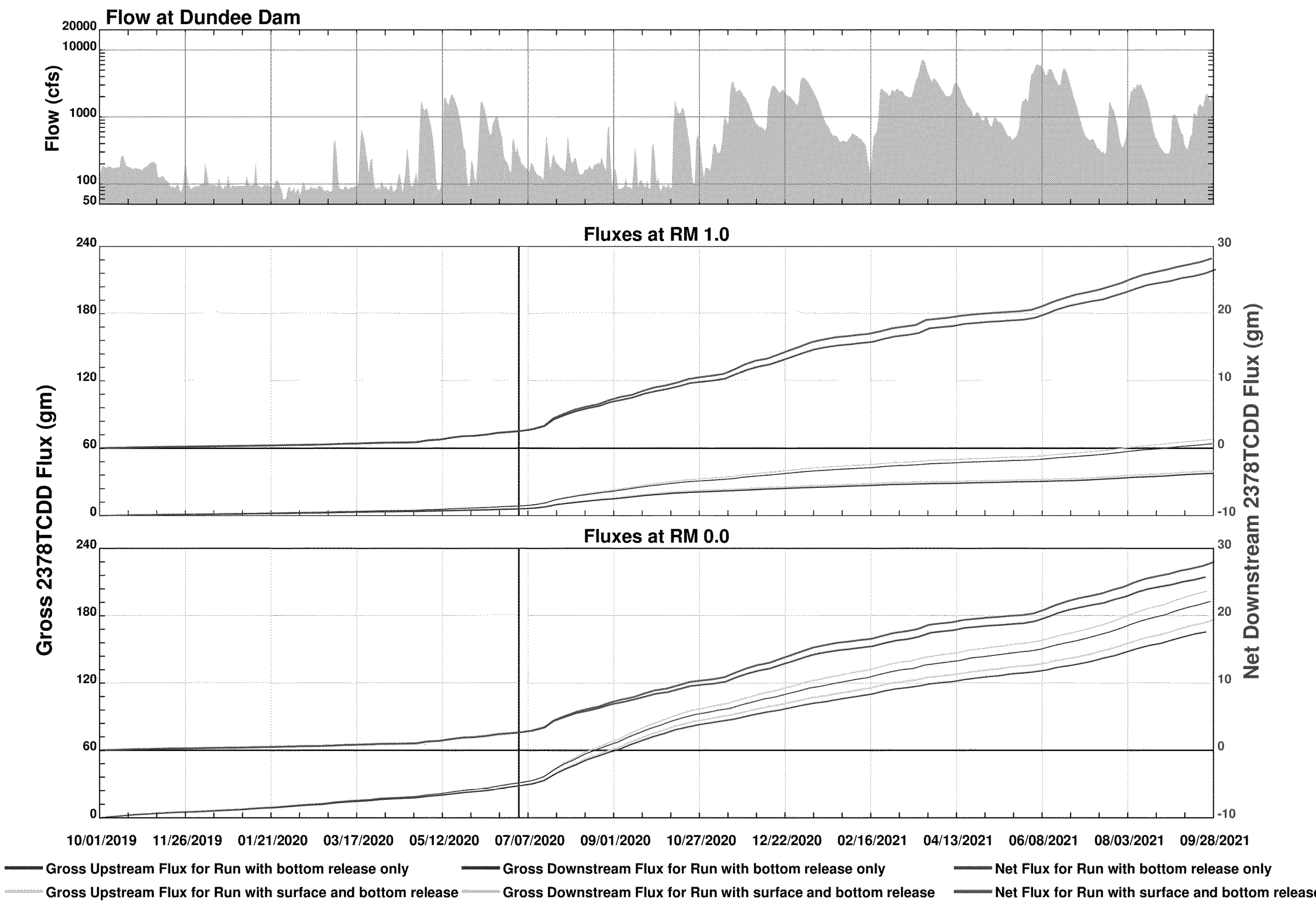

Flow at Dundee Dam
Flow (cfs)
20000
10000
1000
100
50
Fluxes at RM 4.0
Fluxes at RM 2.1
Gross 2378TCDD Flux (gm)
Net Downstream 2378TCDD Flux (gm)
240
180
120
60
0
30
20
10
0
-10
10/01/2019
11/26/2019
01/21/2020
03/17/2020
05/12/2020
07/07/2020
09/01/2020
10/27/2020
12/22/2020
02/16/2021
04/13/2021
06/08/2021
08/03/2021
09/28/2021
Gross Upstream Flux for Run with bottom release only
Gross Downstream Flux for Run with bottom release only
Net Flux for Run with bottom release only
Gross Upstream Flux for Run with surface and bottom release
Gross Downstream Flux for Run with surface and bottom release
Net Flux for Run with surface and bottom release

Figure 2 Flux comparisons at RM 4.0 and RM 2.1



Flow at Dundee Dam
Flow (cfs)
20000
10000
1000
100
50
Fluxes at RM 1.0
Fluxes at RM 0.0
Gross 2378TCDD Flux (gm)
Net Downstream 2378TCDD Flux (gm)
240
180
120
60
0
30
20
10
0
-10
10/01/2019
11/26/2019
01/21/2020
03/17/2020
05/12/2020
07/07/2020
09/01/2020
10/27/2020
12/22/2020
02/16/2021
04/13/2021
06/08/2021
08/03/2021
09/28/2021
Gross Upstream Flux for Run with bottom release only
Gross Downstream Flux for Run with bottom release only
Net Flux for Run with bottom release only
Gross Upstream Flux for Run with surface and bottom release
Gross Downstream Flux for Run with surface and bottom release
Net Flux for Run with surface and bottom release

Figure 3 Flux comparisons at RM 1.0 and RM 0.0